Effects of Too-loud Music on Human Ears

But, Mother, *Rock'n Roll HAS to be Loud!*

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Constant or recurrent exposure to high intensity sound can permanently damage hearing. Pediatricians and otologists are becoming increasingly aware of this danger, especially to teenagers who listen to rock'n roll music and entertainment—"the louder the better."

TEENAGERS continually expose themselves to possible permanent sensori-neural hearing loss in their fascination with bombastic music issuing from record stores, pop music radio stations and local discotheques.

For over a century the professional literature has been issuing warnings on the possible deleterious effects of noise on the human hearing mechanism.[1] It is only in recent years, however, that professional interest in the deafening effects of loud noise has been directed to other than military personnel or industrial workers. The focus of attention is now spreading to our teenagers who delight in either playing or listening to rock'n roll music at high intensity levels. The cost in terms of eventual reduction in hearing efficiency is not yet known, but recent evidence shows that it may be enormous.

Safe Noise Levels

The noise intensity (loudness) levels considered safe for human ears, even for protracted periods, have been well summarized by Kryster: "A fair, perhaps conservative, evaluation of the laboratory . . . studies on stimulation deafness [show] that for long and intermittent exposures any frequency of sound that is 85 dB or less above 0.0002 dyne/cm.^{2} [or acoustic reference "0" dB for sound pressure levels] will not cause any temporary or permanent damage. On the other hand, for brief exposures lasting up to an hour, the intensities necessary to cause deafness appear to be in the order of 100 dB re: 0.0002 dyne/cm.^{2} for any frequency or critical band." [2]

Another study [3] concludes: "If the over-all noise level does not exceed 85 decibels, no injury to hearing results; a noise level of more than 85 and less than 100 decibels may harm the ear of a highly susceptible individual after a long period of exposure; noise levels above 100 decibels may do permanent damage, after long exposure, to the ears of these persons; as the decibel rating of noise rises the damage it can do increases, of course, and noise levels in excess of 130 decibels may do permanent damage to the ears of normal persons, even after a relatively short exposure."

Thus, as the intensity level of unwanted sound, either noise or music, grows in excess of 85 dB, the greater the danger of noise-induced hearing loss. The United States Public Health Service states, "Our data support the recommendations . . . on the desirability of instituting hearing conservation measures where the work [or recreational] environment includes regular, prolonged exposure to steady-state continuous spectrum noise reaching octave band levels of 85 dB." [4]

Glorig [5] feels that four factors should enter into any analysis of the traumatic effects of noise exposure: (1) over-all noise level; (2) composition of noise; (3) duration of exposure during a single 24-hour period; and (4) the total time of exposure during a work-life. His findings support those of earlier experts who believe that possible damage to the hearing mechanism must be related primarily to the

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intensity level of the noise signal and to the length of time under exposure.

Role of Parents

Parents are now beginning to show more concern about their children's hearing. Most adolescents may not listen to music turned up to maximum intensity levels for long periods of time at home; their less adaptable parents usually demand lower sound levels after brief listening periods.

A parent may actually increase the risk of damage to his children by suggesting that they listen to music through headphones. Unfettered by parental monitoring, they may pulse to the rock'n roll ritual with such abandon that permanent damage to the inner ear is almost assured. One author [6] reports finding his teenage daughter and some friends listening to music at a shattering volume through a set of stereo headphones. He asked one of the youngsters if she felt any pain. Her unnerving answer was "of course!" The sensation of pain secondary to sound should serve as a warning that damage to the hearing mechanism may occur.

Generally, however, the greater danger to hearing is not at home, but at teenage clubs or discotheques where children expose themselves to loud music for three- or four-hour periods. Similarly, and of even greater concern, are the effects of sound on members of the rock bands who play their music several hours a week in both practice and concert.

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Our Study of One Combo

In order to measure both the noise (or music) levels in a rock'n roll environment and the hearing abilities of members of a musical combo, we made appropriate observations of five members of a musical combo before, during and after a rehearsal session. Three of the group were 19 years old and two were 20 years old. Our goals were twofold:

1. To determine any possible shifts in hearing threshold efficiency after a two and one-half-hour period of noise stimulation.
2. To determine the maximum sound pressure level readings in the practice room during the loudest segment of the rehearsal.

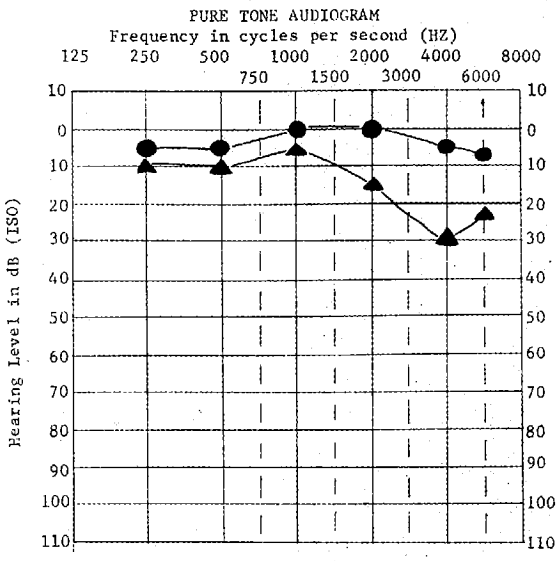

FIG. 1. Comparison audiogram showing median thresholds for ten ears, before and after two and one-half hours of rock'n roll stimulation where sound pressure levels peaked to 130 dB. ●——● = prestimulation thresholds; ▲——▲ = poststimulation thresholds.

Results

Threshold changes were measured by obtaining monaural pure-tone air conducted thresholds at 250, 500, 1,000, 2,000, 4,000, and 6,000 cycles per second (hereafter referred to as Hz) before and immediately following rehearsal. Using portable audiometers equipped with sound-attenuating muffs, the thresholds were measured in a room with ambient noise levels of 35 to 40 dB of sound pressure level (Fig. 1).

After two and one-half hours of rock'n roll stimulation, threshold shifts from pre-stimulation values were minimal at 250, 500, and 1,000 Hz, with an elevation of the threshold by only 5 dB at each frequency. The auditory fatigue factor (also known as temporary threshold shift) became most obvious at higher frequencies: 15 dB shift at 2,000 Hz, 25 dB shift at 4,000 Hz, and 20 dB shift at 6,000 Hz. Our observation that the largest shift occurs at 4,000 Hz agrees with earlier reports.[2, 4, 7]

All musicians reported "ringing" or a "sensation of fullness" in their ears after the rehearsal. With three members these head noises disappeared within three to eight hours after the rehearsal. Two members reported that the sound continued through the following one or two days; these same two also showed the greatest threshold shift following musical

stimulation. As one of our subjects described it, "Man, those wild sounds really become a part of you." Pollack [8] has quoted one 14-year-old: "It embalms you. It has to be so loud that it gets inside you. Otherwise, it isn't any good." Rupp [9] quotes another teenager: "There is an eerie effect in the ears after listening to this [music] for an evening."

The sound pressure levels generated in the practice room during the loudest time period of the rehearsal ranged from 120 to 130 dB. Equipment used was a General Radio Company Sound Level Meter, Type 759-B. All measurements were read using the "C" weighting curve with a sound pressure level range of 85 to 140 dB.

The noise level from a Saturn moon rocket measured from the press site is 120 dB; the noise from a jet engine also peaks at 120 dB; and a very noisy factory produces a sound pressure level of 100 dB. Thus, at the most enthusiastic point in the rock'n roll rehearsal, the noise was louder than each of these examples. After the rehearsal, the group reported that it had really been a poor night to measure the *real* volume of their usual playing; they were preparing for a dance date and were holding back, even though the amplifiers were tuned for maximum output.

According to the safe sound pressure levels reported earlier, the musicians were performing in a sound environment which was potentially damaging to their ears. Lebo and Garrett [10] measured sound pressure levels at two San Francisco discotheques; sound in each peaked at 120 dB. The authors warned that "repetitive exposure to such noise levels is likely to produce progressive, cumulative and permanent inner ear damage."

Discussion

Authors have tried to identify those in the population who are susceptible to hearing loss as the result of excessive noise exposure. No single test yet designed effectively identifies the susceptibles in mass field testing.[5]

Harris [11] concludes: "There are, as yet, no acceptable tests to determine susceptibility other than the practice of repeat audiometry. By repeating the measurement of hearing tests at reasonable intervals of a year or less, the highly susceptible . . . can be detected by noting the change in hearing loss measured at frequencies above 2,000 cps, where changes occur at the greatest rate with increased exposure."

In addition to regular audiometric testing of rock'n roll musicians, two other preventative measures could be implemented to protect the hearing of both musician and spectator:

1. **Musicians should wear customized ear defenders or protectors to reduce by 20 to 30 dB the intensity of noise reaching the ears, thus lowering noise levels below the damaging 100 to 120 dB level.**
2. **Local or regional governmental units should establish safe maximum sound pressure levels for electronic amplifiers in public clubs and discotheques with a suggested 100 dB as the maximum level of output.** Regulations must be supported by appropriate penalties, and calibration of electronic amplifiers with monitored safe-level limits could be established through psychoacoustic laboratories or local health departments.

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